

Section 7 Asset Class – Pavement System:

The Pavement System asset class consists of the street surfaces of Seattle’s street network and includes:

- ✓ Pavement

In 2003 an thorough estimate of paving costs was prepared using existing pavement condition data, construction and maintenance costs effective in 2003, and project requirements effective in 2003. Since that time, paving costs have nearly doubled due to market forces in the construction industry, oil price hikes, and new mandates:

- ✓ Guidelines in the Americans with Disability Act (ADA), which took effect in 2003, require that paving projects replace or retrofit curb ramps to meet new accessibility standards.
- ✓ State safety rules limited the equipment that could work around Metro trolley bus lines, pushing work onto weekends at overtime rates.
- ✓ Beginning in 2006, Seattle Public Utilities (SPU) began requiring drainage improvements on all SDOT paving contracts that involved full-depth pavement repairs. Paving projects must now install storm water detention and treatment facilities in accordance with the City’s National Pollutant Discharge Elimination System (NPDES) permit to meet SPU requirements.
- ✓ The provisions of the “Complete Streets” ordinance and resolution require that the ROW be improved for all modes of transportation under certain conditions whenever major maintenance is undertaken.

During the year 2010 The Street Maintenance division conducted a condition assessment of the arterial pavement and will produce a new Pavement Report based on that information, with updated cost information. That information was not available for this report update.

Pavement:

Pavement is divided into four (4) major categories:

- ✓ Arterial
- ✓ Non-Arterial
- ✓ Alley ways
- ✓ Excess ROW in use for access and parking

Pavement must have adequate structure to support the traffic it carries at the roadway’s design speed and must also withstand environmental degradation. Pavement also serves a secondary function as drainage structures, channeling runoff to collection facilities.

The total arterial and non-arterial pavement network in Seattle is 3,943 12-foot-wide lane miles. This figure is based on a pavement management assessment conducted in 2005-2006.

Since the majority of the pavement infrastructure is represented by the arterials and non-arterials, these two pavement categories were emphasized in this report.

Arterial Pavement:



Arterials are Seattle's busiest streets. They are classified according to the traffic they carry:

- ✓ Principal arterial – the most important, busiest through-streets, such as Rainier Ave S or 15th Ave NW
- ✓ Minor arterial – streets that link neighborhoods together, such as California Ave SW or N 80th ST
- ✓ Collector arterial – streets that tie the least traveled streets, the non-arterials, into the arterial street system

Current Inventory and Anticipated Annual Growth:

Arterials account for 39% of the pavement network of Seattle, or 1,531 12-foot-wide lane miles. The break-down of arterials according to the functional classification is:

Functional Classification	Pavement Area (12-ft Lane Miles)	Fraction of Network
Principal Arterial	617	40%
Minor Arterial	567	37%
Collector Arterial	347	23%

The arterial pavement inventory is maintained in the Pavement Management database system where condition and maintenance information is also recorded. New pavement is entered into the database annually, and condition ratings are updated every three (3) years. The city adds very little to the street network annually. Additions that occur are usually in connection with redevelopment or (rarely) annexation.

The arterial pavement network replacement cost is estimated at \$2.77 billion in 2010 dollars, not including the cost of the right-of-way, and the cost of drainage and other improvements that might be required or desired if streets were reconstructed.

Condition Ratings:

The pavement condition survey was conducted using an automated system that used an array of cameras and sensors to record pavement distress. In addition to pavement distress information, digital photo logs were collected.

Pavement condition is assessed using an industry-standard rating methodology described in Appendix C to derive a Pavement Condition Index (PCI).

Arterial Pavement Condition Ratings 2007

Condition Rating	PCI Index	Lane Miles	Percent of Arterials
Good	56-100	1103	72.1
Fair	41-55	230	15
Poor	0-40	232	15.2

Useful Life and Life Cycle Costs:

The costs figures used in this section are based on 2003 conditions. This section is not updated for the most recent information, since the 2010-2011 pavement Report is forthcoming.

The useful life and life cycle costs for arterial pavement vary depending on the surface type:

Useful Life & Life Cycle Cost of Arterial Pavement

Street Surface	Useful Life (years) Condition of Pavement			Life Cycle Cost (per lane mile)	
	Good	Fair	Poor	Construction	Rehab/ Renewal
Asphalt	6-20	1-5	<1	\$1.2 million	\$528,000 (overlay)
Concrete	10-40	1-10	<1	\$1.8 million	\$440,000 (select panel replacement)

Delayed repairs on arterial pavement, where the pavement condition indicates a need, will create deferred maintenance. Deferred maintenance is work that is postponed to a future budget cycle or until funds are available. As maintenance is continuously deferred, arterial pavement deteriorates to the point where it will eventually need to be replaced or reconstructed.

When an existing pavement structure is sound, the driving surface can often be renewed at a fraction of the cost of digging up and replacing the entire roadway. A recent example of surface renewal is the resurfacing work on N/NE 45th St. If the major maintenance treatment is not applied, the arterial pavement structure continues to deteriorate to the point where it must be completely reconstructed. Reconstruction, where the entire pavement structure is removed and replaced, is approximately 5-7 times more costly than resurfacing or other forms of major maintenance. Pavement managers strive to follow a lowest life-cycle-cost approach to pavement maintenance, resurfacing or otherwise rehabilitating arterial pavement when conditions allow.



**Arterial Pavement
Mercer Street**

Maintenance Approach:

Arterial streets are subdivided by surface type. Seattle has three (3) primary arterial surface types:

- ✓ Portland cement concrete (PCC)
- ✓ Asphalt concrete over Portland cement concrete or other rigid base (AC/PCC)
- ✓ Asphalt concrete over flexible base (AC)

Bituminous surface treatment (BST), commonly called Chip Seal, and other surface types, such as brick or stone or gravel, make up only a small fraction of the arterial street network. Each pavement type has different maintenance requirements. A breakdown of arterial pavement types is shown below.

**Arterial Street Pavement Area
By Surface Type**

Surface Type	Pavement Area (Lane Miles)	Percent of Arterials
PCC	515	33.6
AC/PCC	887	58
AC	121	7.9
BST and Other	8	0.5

SDOT currently provides three (3) basic types of maintenance services for arterial pavement:

- ✓ Spot repair
- ✓ Routine or preventive maintenance
- ✓ Reconstruction

Spot repair is completed within two (2) business days of customer complaint 95% of the time.

Routine or preventive maintenance is performed as funds permit at the following intervention levels:

- ✓ Mill-and-overlay with asphalt concrete when PCI rating is 41-60 on AC and AC/PCC arterials
- ✓ Partially reconstruct in asphalt concrete when PCI rating is 31-40 on AC and AC/PCC arterials
- ✓ Replace select Portland cement concrete panels when PCI rating is 41-55 on PCC streets

Reconstruction is performed as funds permit at the following intervention levels:

- ✓ Reconstruct in Portland cement concrete when PCI rating is 40 or less on PCC arterials, and 30 or less on AC/PCC arterials
- ✓ Reconstruct in asphalt concrete when PCI rating is 30 or less on AC streets

Current Performance Measures:

SDOT Street Maintenance has established the following performance measures for pavement:

Performance Measure	2009 /Actual	2010 Goal
Lane miles of streets re-paved	28	22

Funding Requirements:

In 2010, Street Maintenance will have an annual budget of \$22.5 million for major maintenance (re-surfacing) of arterial pavement and an additional \$7.6 million for operations, such as street sweeping and pothole filling.



Non-Arterial Pavement

Prior to BTG, the maintenance budget for arterial pavement provided the ability to complete spot safety repair and a small amount of arterial re-surfacing. The result of this lower level of funding has been a deferred maintenance backlog of 427 lane miles of arterial pavement.

Street Maintenance estimates that elimination of the deferred maintenance backlog would require a 20-year program to resurface an additional 30-60 lane-miles/year and reconstruction of an additional 7-11 lane-miles/year.

Unmet Funding Needs:

The funding requirements are based on 2003 figures. The intervening impacts of market forces, oil price hikes, and new mandates need to be accounted for in assessing out-year funding requirements. In 2008, SDOT will re-estimate construction costs and anticipates disproportionate increases in the price of construction materials, based on recent market experience. This will likely result in higher cost estimates and additional funding needs.

Non-Arterial Pavement:

Non-arterials are Seattle's least trafficked streets. Non-arterial streets serve a variety of users. The majority of non-arterials are neighborhood residential streets, but some also support industry in areas such as south of downtown (SODO), South Park, and the Ballard/Interbay Manufacturing Industrial (BINMIC) areas. Because of their limited use, non-arterials are typically of lighter construction than arterials, however, they still must have adequate structure to support the heavy vehicles they carry and resist environmental degradation, as well as drain properly.

Current Inventory, Condition Ratings, and Anticipated Annual Growth:

Non-arterials account for 61% of the pavement network of Seattle, or 2412 12-foot-wide lane miles. Unlike arterials, non-arterials are not classified by functional use.

The non-arterial pavement inventory is maintained in the Pavement Management database system. Unlike arterial pavement, limited funds have been available to provide information to effectively manage these assets. Inventory data has been updated on an incident basis, and basic information on surface type and construction history is available, but current condition information is not.

Some general information is known about non-arterial pavement.

- ✓ More than half of Seattle's non-arterial streets were constructed of Portland cement concrete during the first half of the twentieth century. These streets, most of which are lightly traveled, have not required much maintenance. However, the age of the pavement suggests many are past their design life.
- ✓ About 25% of Seattle's non-arterial streets were converted in the 1960s and 1970s from gravel roads to a low-cost surface treatment called BST or chip seal. Chip seal streets need to be

resealed on a regular basis or else they begin to deteriorate rapidly because the chip seal does not provide significant pavement structure to support traffic. The surface coat simply seals the surface.

If condition assessments were conducted on non-arterial pavement, the same method used on arterial pavement would likely be used. A statistical or sampling approach could be used to control costs and still maintain a reasonable level of accuracy.

The non-arterial pavement network replacement cost is estimated at \$3.5 billion not including the cost of the right-of-way, and the cost of drainage and other improvements that might be required or desired if streets were reconstructed.

Useful Life and Life Cycle Costs:

Funding for non-arterial pavement has been very limited and, hence, reliable cost figures are not available. The costs figures used in this section are rough estimates derived by discounting the arterial paving costs by 20% to account for the thinner pavement sections and reduced traffic control on non-arterials.

The useful life and life cycle costs for non-arterial pavement vary depending on the surface type.



**Non-Arterial Pavement
in a Seattle Neighborhood**

Useful Life & Life Cycle Cost of Non-Arterial Pavement

Street Surface	Useful Life (years) Condition of Pavement			Life Cycle Cost (per lane mile)	
	Good	Fair	Poor	Construction	Rehab/ Renewal
Asphalt	6-25	1-5	<1	\$900,000	\$25,000 (Chip Seal) \$420,000 (overlay)
Concrete	10-50	1-10	<1	\$1.4 million	\$360,000 (select panel replacement)

Delayed repair on non-arterial pavement has the same impact as it does on arterial pavement.

Maintenance Approach:

Non-arterial streets are subdivided by surface type. Seattle has four (4) primary non-arterial surface types:

- ✓ Portland cement concrete (PCC)
- ✓ Asphalt concrete over Portland cement concrete or other rigid base (AC/PCC)
- ✓ Asphalt concrete over flexible base (AC)
- ✓ BST (Chip Seal)

Brick, stone or gravel (classified as Other) make up a small fraction of the non-arterial street network. Each pavement type has different maintenance requirements. A breakdown of non-arterial surface types is shown below. The table also contrasts SDOT non-arterial pavement maintenance practices with the standard replacement cycles for each surface type.

Non-Arterial Street Pavement Area by Surface Type

Surface Type	Pavement Area (Lane Miles)	Percent of Non-Arterials	Industry Standard Replacement Cycle (Years)	SDOT Replacement Cycle (Years)
PCC	1279	53	40+	None
AC/PCC	8	0.3	20+	None
AC	567	23.6	20+	None
BST (Chip Seal)	550	22.8	7	None
Other	8	0.3	varies	None

SDOT currently provides two (2) basic types of maintenance services for non-arterial pavement:

- ✓ Spot repair
- ✓ Routine or preventive maintenance (rehabilitation)

Spot repair is completed two to three business days of customer complaint 95% of the time. Spot repair does not improve non-arterial pavement condition, but is a stop-gap measure to keep the streets in a safe driving condition until a major rehabilitation project can be undertaken.

Routine or preventive maintenance (rehabilitation) is performed as funds permit at the following intervention levels:

- ✓ Repair 1.5 lane-miles per year of high-use asphalt and concrete non-arterial pavement
- ✓ Re-seal BST pavements at 30-40 lane miles per year, or on a 13-18 year cycle. Street Maintenance believes that a 10-year cycle is advisable to prevent further serious degradation of these aging streets. Chip sealing is SDOT's only regular non-arterial maintenance program, demonstrating the cost effectiveness of timely, regular street maintenance. Since the late 1960s, the program maintained in serviceable condition 553 lane-miles of non-arterial streets. However, even the chip seal program lags behind the level of funding necessary to meet the 10-year target return cycle. A modest increase in chip-seal annual funding would shorten the time interval between maintenance treatments and allow the program to try some new seal methods, e.g., slurry seals, which have the potential to improve customer satisfaction while maintaining the same level of service.

Funding is not available to reconstruct or replace non-arterial pavement. Street Maintenance believes that the non-arterial pavement should be reconstructed on the following cycles:

- ✓ Replace concrete pavements on a 160-year cycle, requiring reconstruction of approximately eight (8) lane miles of PCC paving per year
- ✓ Overlay asphalt pavements on a 25-year cycle, requiring approximately 24 lane miles of AC paving per year

The rehabilitation and reconstruction cycles proposed by Street Maintenance were derived from professional judgment based on industry standards, field observation of non-arterials, and an effort to balance what is desirable from an engineering standpoint with what is achievable and practical from a budget standpoint.

Current Performance Measures:

Performance measures have not been developed for non-arterial pavement.

Funding Requirements:



Non-Arterial Pavement

The 2010 annual Street Maintenance budget is \$1 million for maintenance of non-arterial pavement and an additional \$2.9 million for operations, such as pothole filling. No BTG funding has been provided for non-arterial pavement. This maintenance budget primarily provides spot safety repair and a small amount of asphalt and concrete rehabilitation, including the Chip Seal Program.

Estimation of maintenance needs for non-arterials is challenging because condition information is not available. Without up-to-date condition information, the maintenance need

cannot be assessed on the basis of condition as it was for arterial pavement. As is evident, SDOT is not replacing non-arterial pavement in contradiction of industry standards.

In 2004, a maintenance program was proposed, but not enacted. This program was a compromise to an aggressive reconstruction program, as has been outlined above. This program outlined funding requirements for each surface type.

Non-Arterial Maintenance Cycles

Surface Type	Proposed Maintenance Cycle (Years)	Annual Cost (Millions)
PCC	160	\$9.6
AC/PCC	25	\$0.4
AC	25	\$4.4
BST (Chip Seal)	10	\$1.0
Other	10	\$0.1
Total		\$15.5

The maintenance approach outlined above does not take into account the asphalt surfaced pavements that have already failed or will fail because of deferred or inadequate maintenance. Those streets will require reconstruction at an additional cost beyond the annual cost estimate provided above.

Unmet Funding Needs:

As part of the proposal outlined above in 2004, Street Maintenance determined an annual rehabilitation program funded at \$15.5 million would be needed to maintain non-arterial pavement.